1.

The atrio-ventricular node (AVN), bundle of His and Purkyne (Purkinje) fibres are specialised cardiac muscle tissues which are involved in the control of heartbeat.

*(a)* State the function of the following structures in the functioning of the heart.

(i) atrio-ventricular node (AVN); [2]

.....

.....

(ii) bundle of His and Purkyne fibres. [2]

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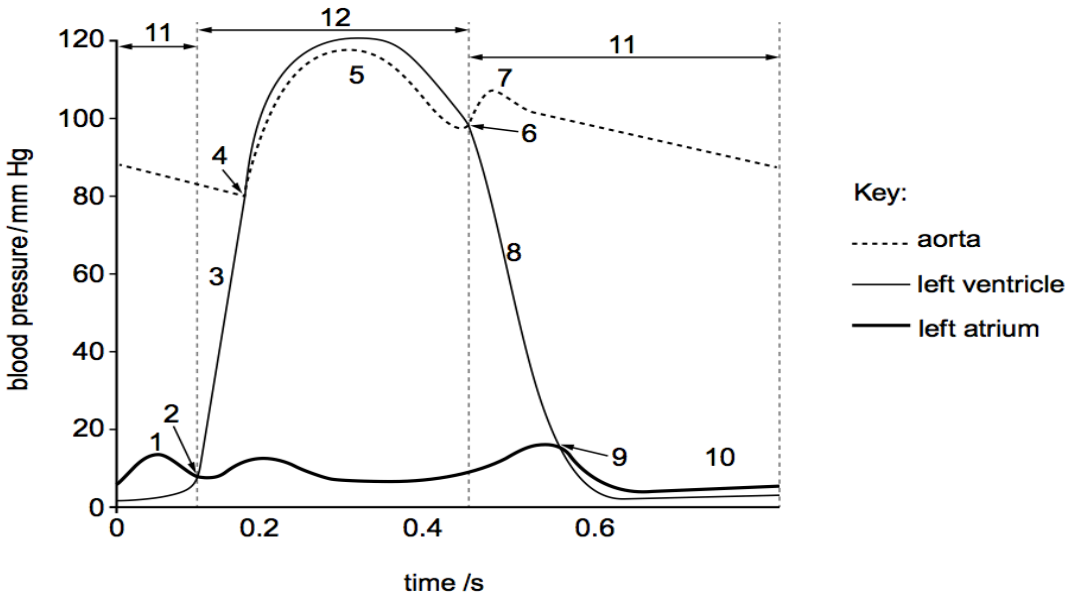
.....

The graph below shows the pressure changes in the left ventricle, left atrium and aorta during one cardiac cycle.




(b) The following statements list events or phases that occur during a cardiac cycle. State the numbers indicated on the graph above that correspond to **each** of the following statements. [8]

(i) ventricular diastole (ventricles are relaxing) .....

(ii) recoil of aorta .....

(iii) atrial systole .....

(iv) closing of semi-lunar valves .....

(v) opening of semi-lunar valves .....

(vi) atrio-ventricular valves close .....

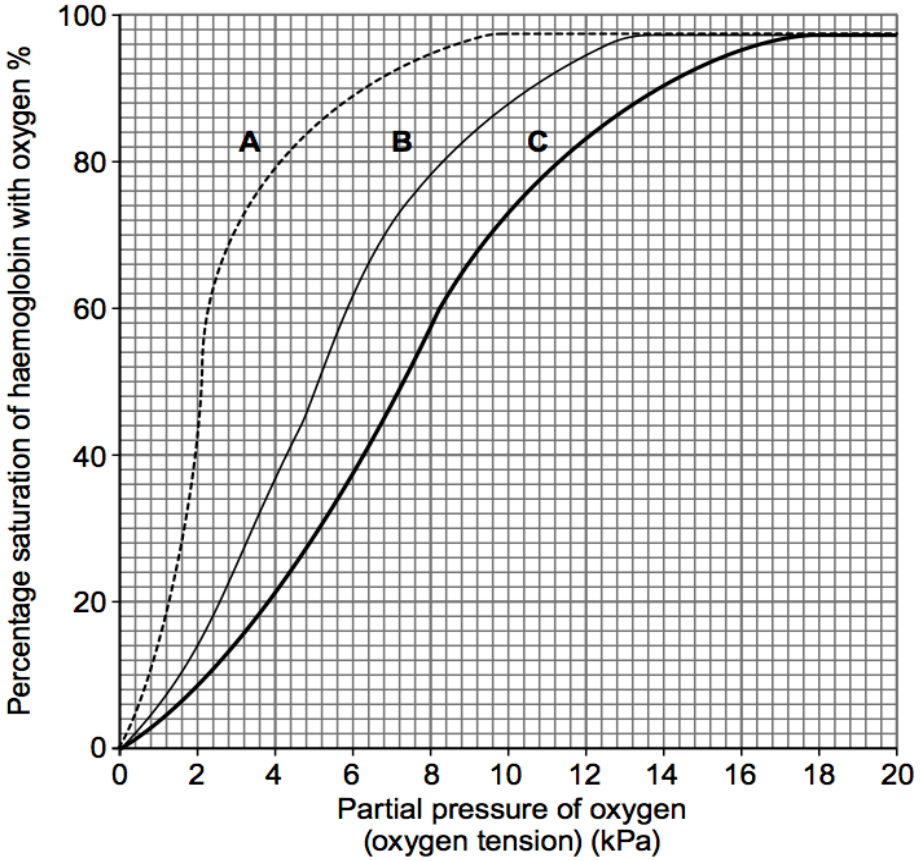
(vii) ventricular systole (ventricles are contracting) .....

(viii) passive filling of atrium by venous return .....

2.

*(a)* The graph below shows the oxygen dissociation curve for three mammals.

Graph **A** is the curve for a llama which is a mammal that lives at high altitudes. Graph **B** is the curve for a domestic cat and graph **C** is the curve for a mouse which is a small mammal with a high metabolic rate.




**Key:**

**A** = llama
**B** = domestic cat
**C** = mouse

(i) What is the percentage saturation of the cat's haemoglobin with oxygen when the partial pressure of oxygen in the muscle tissue of a cat is 3.0kPa.? [1]

.....

(ii) Explain the circumstances under which the partial pressure of oxygen may fall to 3.0kPa in muscle tissues. [2]

.....

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(b) State which of the three curves represents the haemoglobin with the lowest affinity for oxygen at 3.0kPa. [1]

.....

(c) If the pH of the blood became more acidic, the position of curve **C** for the mouse would change.

(i) Draw on the graph opposite the new position of curve **C** when the blood becomes more acidic. [1]

(ii) Explain the benefits to the mouse of this change in position of curve **C**. [3]

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(d) Explain how curve **A** for the llama shows that its haemoglobin is well adapted for its environment. [3]

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(e) State which of the three curves could represent the oxygen dissociation curve of a lugworm. [1]

.....

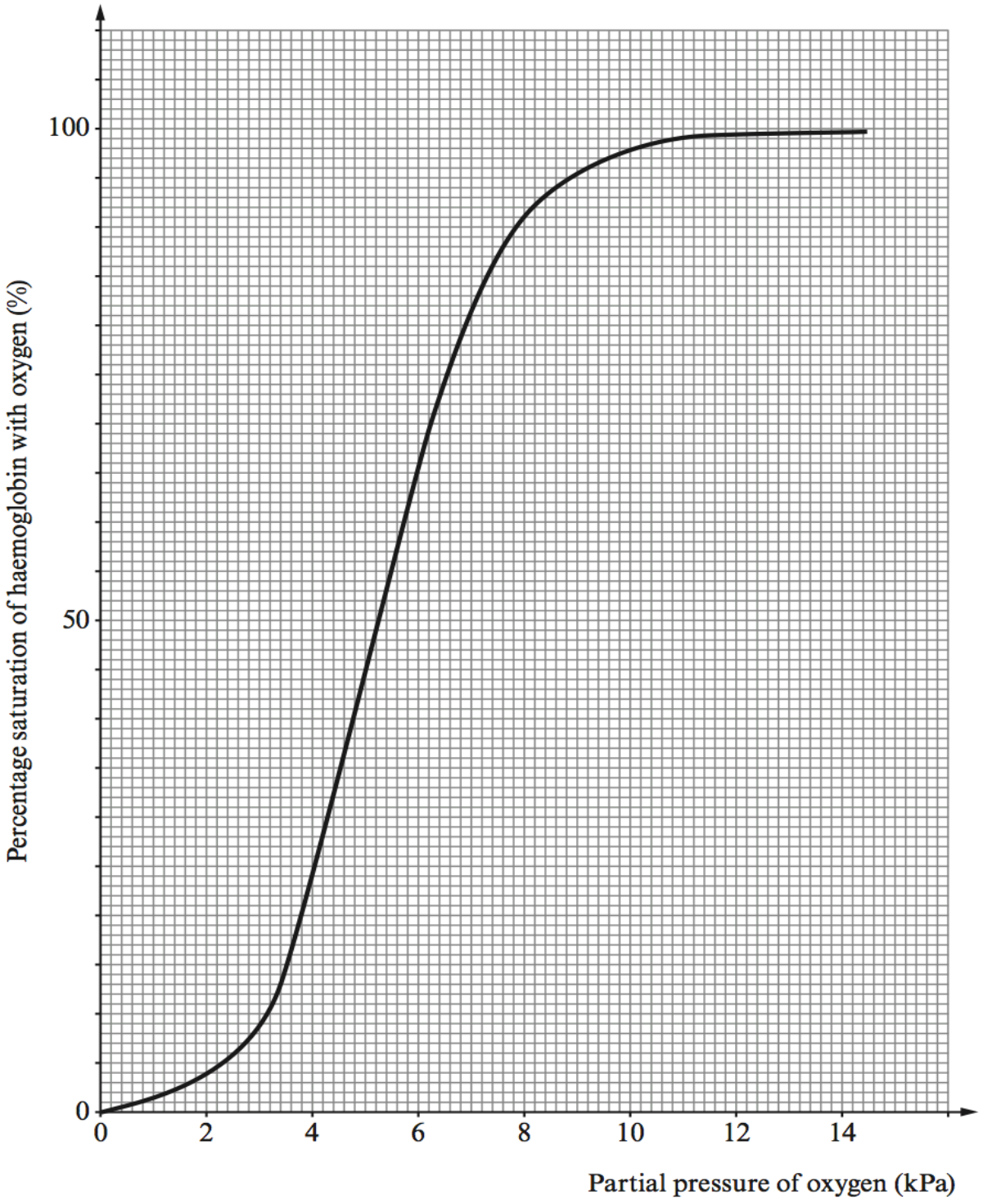
**3.**

The graph below shows the relationship between partial pressure of oxygen and the percentage saturation of haemoglobin in the blood of a human **adult**.

*(a)* (i) State the name given to the curve shown on the graph below. [1]

.....

(ii) Draw another curve on the axes below showing the relationship for **human foetal** haemoglobin. [1]



(iii) Explain the advantage of the position of the curve for **human foetal** haemoglobin. [2]

*(b)* (i) What would happen to the curve for adult haemoglobin if the partial pressure of carbon dioxide increased? [1]

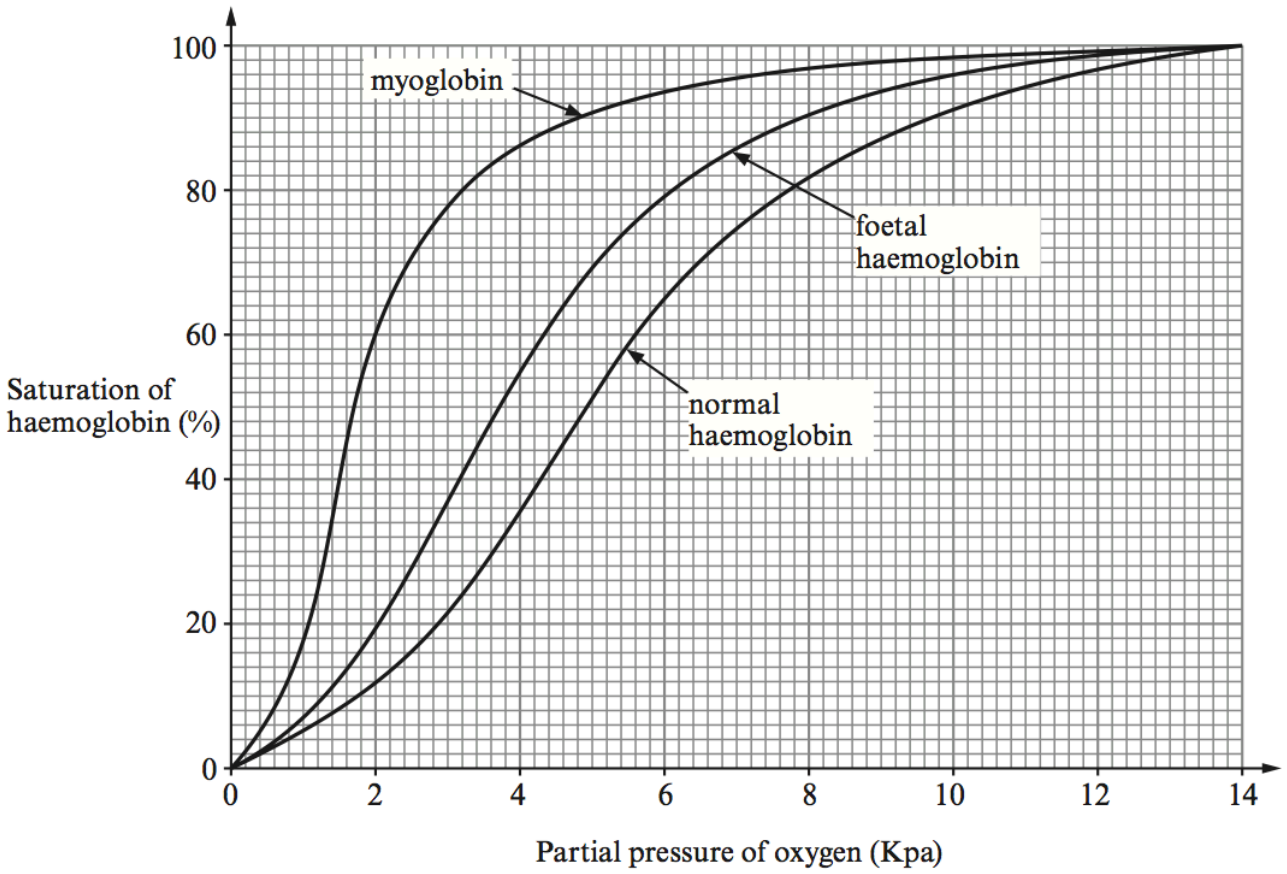
(ii) What is the name of this effect? [1]

(iii) Explain the mechanism and the significance of this effect during exercise. [4]

**4.**

**4.** *(a)* Describe and explain the effect of an increase in carbon dioxide concentration in the blood on the release of oxygen from haemoglobin. [4]

*(b)* The graph shows the oxygen dissociation curves for myoglobin (which is found in muscle), foetal haemoglobin and normal adult haemoglobin.




(i) Give the percentage saturation with oxygen of foetal haemoglobin and normal haemoglobin at a partial pressure of oxygen of 4 kPa. [1]

foetal haemoglobin .....

normal haemoglobin .....

(ii) Use the graph and the results in (i) to explain how this difference in percentage saturation enables the foetal haemoglobin to carry out its function. [3]

(iii) Use the graph to suggest a function for myoglobin. [1]

**(Total 9 marks)**

**5.**

A mammalian heart will continue to beat after it is removed from the body. The sino-atrial node (SAN) acts as a pacemaker and sends a wave of excitation across both atria. The wave reaches a second node, the atrio-ventricular node (AVN), 0.045 seconds after leaving the SAN. A group of fibres, known as Purkinje fibres, arise from the AVN and are known as the Bundle of His. A time delay of 0.12 seconds occurs at the AVN before the wave passes to the Bundle of His. The wave passes to the bases of the two ventricles and then spreads up the side walls of the two ventricles.
The wave reaches the base of the two ventricles 0.04 seconds after leaving the AVN and reaches the top of the ventricles 0.08 seconds after leaving the AVN.

*(a)* Complete the table to show the timing of a wave of excitation as it passes through the heart. [2]

| *Position* | *Time from start of wave / s* |
|---|---|
| SAN | 0.000 |
| AVN | 0.045 |
| Bundle of His | |
| base of ventricles | |
| top of ventricles | 0.245 |

*(b)* Which piece of evidence from the above paragraph suggests that the heart muscle is myogenic? [1]

.....

.....

*(c)* There is a delay of 0.12 seconds in transferring the wave from the AVN to the Bundle of His. Explain the advantage of this delay. [3]

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*(d)* Explain the advantages, for efficient pumping of blood out of the heart, for the wave of excitation to pass from the base of the ventricles upwards. [2]

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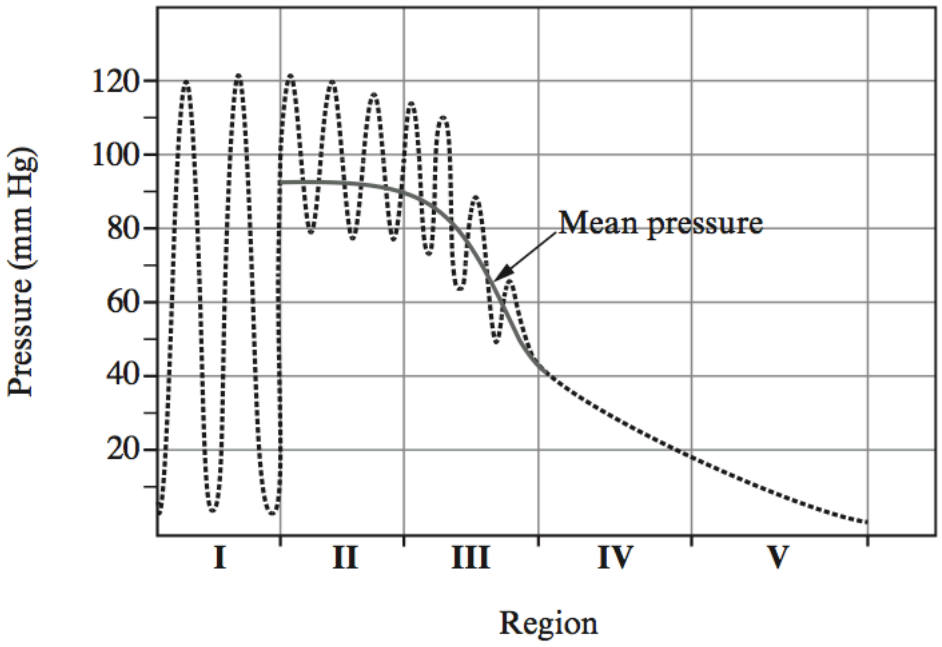
*(e)* An electrocardiogram (ECG) shows electrical activity that takes place in the heart muscle as the heart beats.
Complete the table to show the action of the heart and its associated ECG activity. [2]

| *Cardiac control* | *Action of heart muscle* | *ECG activity* |
|---|---|---|
| SAN impulse | | P wave |
| Purkinje tissue | ventricle contracts | |

**(Total 10 marks)**

**6.**

*(a)* The graph below shows how the blood pressure changes as the blood is transported through the human circulatory system.




(i) Region **I** of the graph shows the blood pressure in the left ventricle and region **II** shows the blood pressure in the aorta.

Explain fully the reasons for the differences in the maximum and minimum blood pressure in the left ventricle and the aorta. [3]

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(ii) Why does the blood pressure decrease so rapidly in region **III**? [1]

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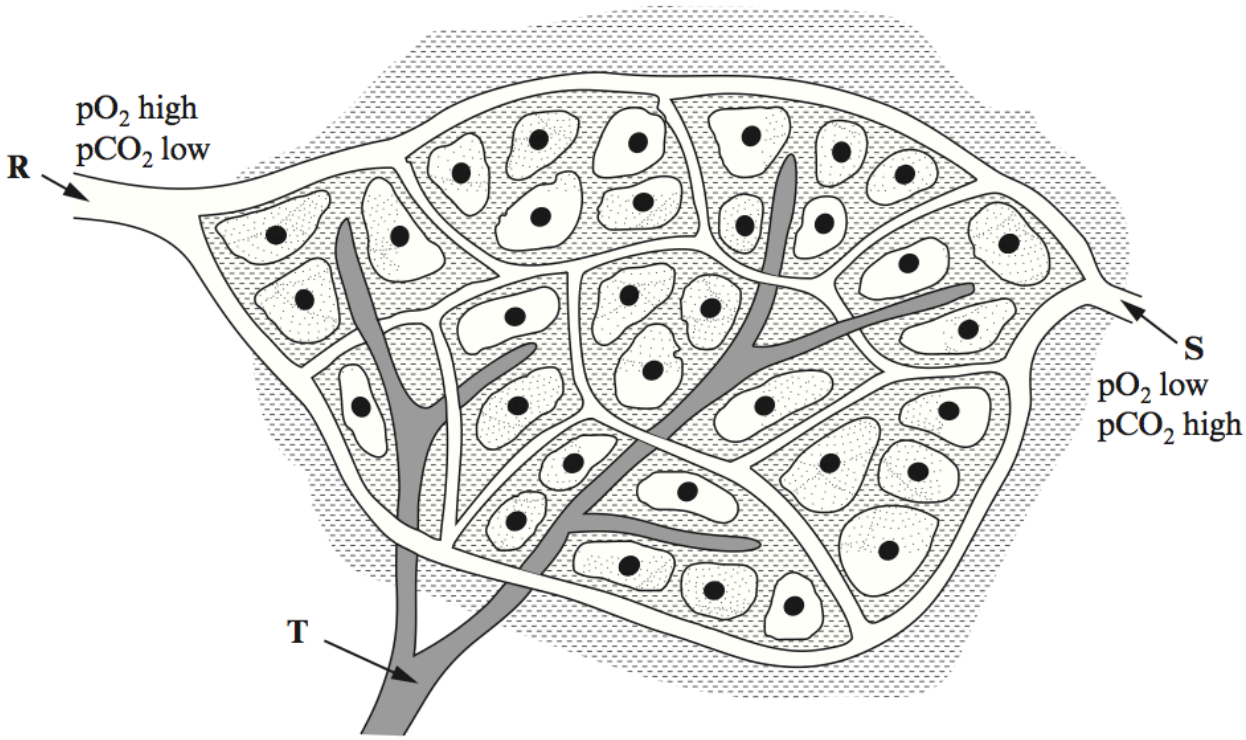
.....

*(b)* The diagram below shows the blood supply to the cells of the body tissues. The relative amounts of oxygen and carbon dioxide in the blood vessels are given.




(i) Which of vessels **R** and **S** represents the arterial end of the blood supply to the tissues? Give a reason for your answer. [2]

.....

.....

.....

(ii) Explain how differences in the hydrostatic and osmotic pressures between the arterial and venous ends of the blood supply results in the formation of tissue fluid. [3]

.....

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.....

.....

(iii) What is the function of the vessel labelled **T** in the diagram? [1]

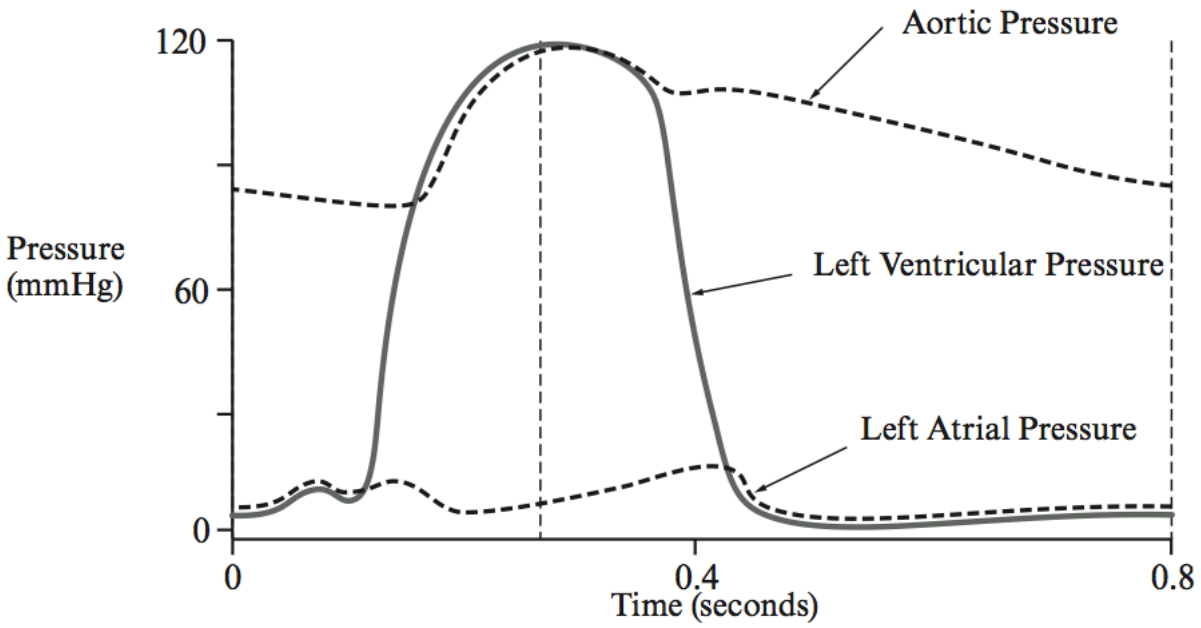
.....

.....

**(Total 10 marks)**

**7.**

The cardiac cycle diagram below depicts changes in aortic pressure, left ventricular pressure, left atrial pressure during a single cycle of cardiac contraction and relaxation.




*(a)* On the diagram above:

(i) Indicate with a letter **A** where the aortic semi lunar valve opens and with a **B** where it closes. [2]

(ii) Indicate with a letter **C** where the left atrioventricular (bicuspid) valve opens and with a **D** where it closes. [2]

*(b)* Why does the ventricular pressure fall to zero, whilst the aortic pressure does not fall below 80mmHg? [2]

.....

.....

*(c)* Using the information in the diagram above, calculate the rate of heartbeat for one minute. Show your working. [2]

Answer .....

The table below shows the pressure in different areas of the heart.

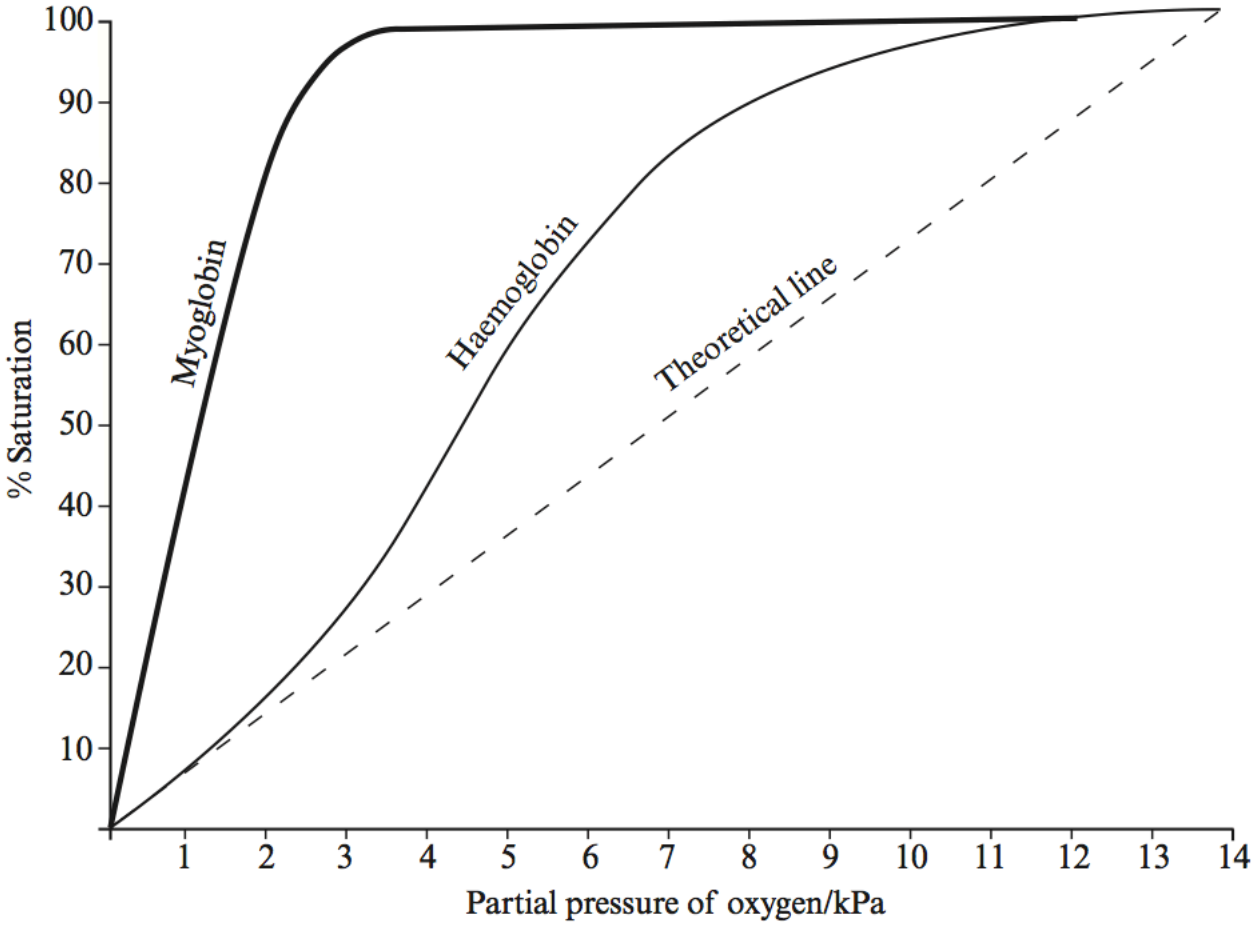
| *Region of heart* | ***Maximum** Pressure (mmHg)* |
|---|---|
| Right Atrium | 4 |
| Right Ventricle | 25 |
| Pulmonary Artery | 25 |
| Left Atrium | 10 |
| Left Ventricle | 120 |
| Aorta | 120 |

*(d)* Using the information in the table above, explain the difference in pressures between the **left atrium**, **left ventricle** and **right ventricle**. [3]

**(Total 11 marks)**

**8.**

The oxygen requirement of active muscle tissue is normally provided by oxyhaemoglobin. The diagram below shows the uptake of oxygen by haemoglobin at different partial pressures of oxygen. The dotted line represents a theoretical situation in which the rate of uptake was proportional to the concentration of oxygen.




*(a)* List the **two** ways in which the shape of the haemoglobin dissociation line differs from the theoretical line. [2]

1. .....

2. .....

*(b)* The partial pressure of oxygen in the lungs is usually about 13kPa and in muscle tissue usually below 5kPa.
Explain the biological significance of the differences between the haemoglobin dissociation line and the theoretical line:

(i) at a partial pressure of 13kPa; [1]

.....

.....

(ii) at a partial pressure of 4kPa; [1]

.....

.....

(iii) when the partial pressure changes from 8kPa to 5kPa. [1]

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*(c)* Describe how oxygen is released from the haemoglobin molecule. [3]

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*(d)* The other dissociation curve on the diagram is for a myoglobin molecule. Suggest how myoglobin can perform a useful function in muscle tissue. [3]

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**(Total 11 marks)**

**9.**

Most of the carbon dioxide (85%) transported in the human blood stream is carried as bicarbonate ions.

*(a)* Describe the **two** *other* ways in which the remaining 15% is carried. [2]

.....

.....

*(b)* Carbon dioxide enters a red blood cell (erythrocyte) and is converted into carbonic acid by an enzyme.

(i) Name this enzyme. [1]

.....

(ii) Since carbon dioxide dissolves in water to form carbonic acid anyway, explain why the enzyme is necessary. [1]

.....

*(c)* The carbonic acid in the red blood cell is ionised into hydrogen ions and bicarbonate ions.

(i) Describe what then happens to the bicarbonate ions. [1]

.....

(ii) Describe the function of the hydrogen ions produced in the red blood cell and explain its importance in muscle tissue. [2]

.....

.....

(iii) Name **one** *other* ion involved in carbon dioxide transport and describe its function. [2]

.....

.....

*(d)* The solubility of carbon dioxide in water is a concern for ecologists as a consequence of increasing carbon dioxide levels in the atmosphere. Suggest a reason for this concern with an example of a problem that might arise. [2]

.....

.....

**(Total 11 marks)**

**10.**

*(c)* (i) What environmental factor could account for the displacement of the curve from A to B? [1]

.....

(ii) Name this displacement of the curve. [1]

.....

(iii) What is the significance of this effect? [1]

.....

.....

*(d)* (i) Draw another curve on the diagram to show the relative position of the haemoglobin dissociation curve for the blood of llamas which live in the high Andes of South America. [1]

(ii) Explain the significance of the relative position of the curve you have drawn. [2]

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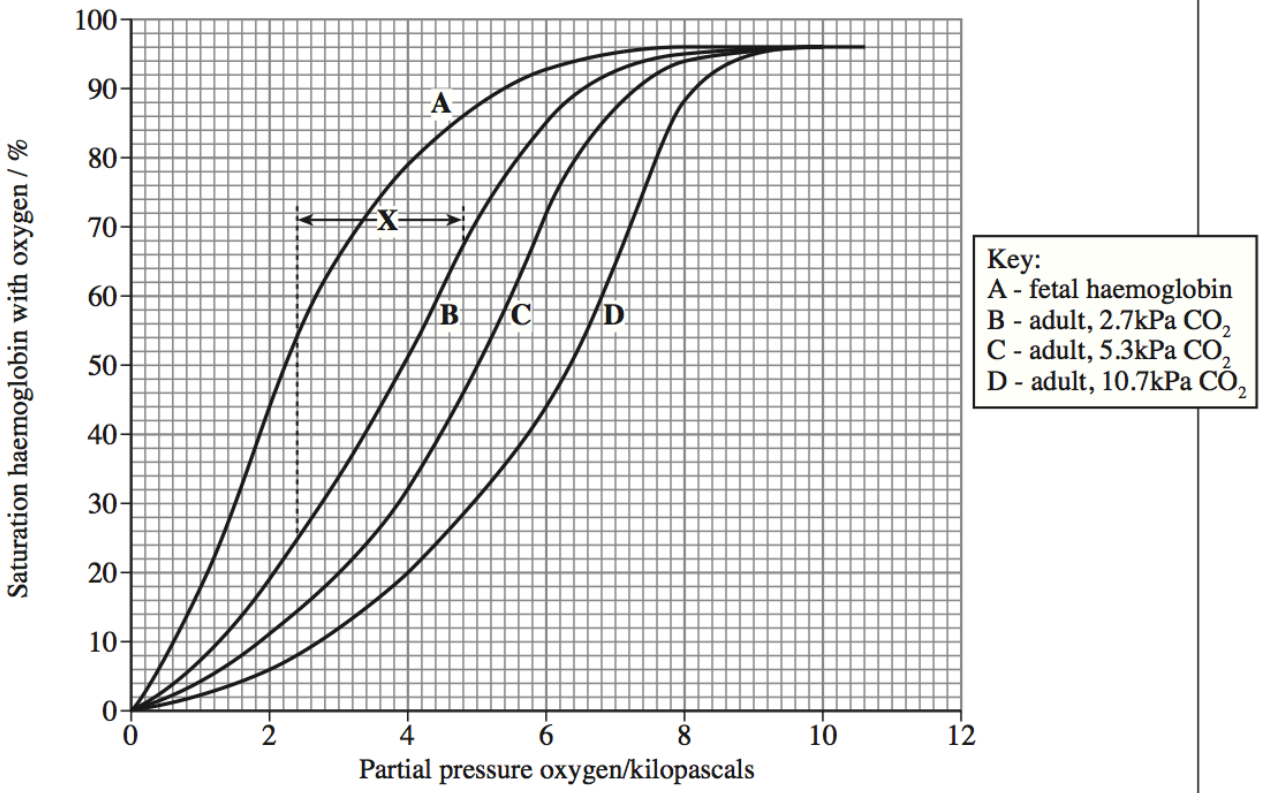
(iii) Suggest **one** change which could be observed in the blood of an athlete who had been training at high altitude? [1]

.....

**(Total 10 marks)**

**11.**

**2.** The oxygen dissociation curves below, show the relationship between the partial pressure of oxygen and the percentage oxygen saturation of two respiratory pigments. Curve A shows the response of fetal haemoglobin and curves B, C and D the response of adult haemoglobin in the blood at three different partial pressures of carbon dioxide.




*(a)* (i) How many **molecules** of oxygen can one molecule of haemoglobin carry when it is fully saturated ? [1]

.....

(ii) What percentage of the oxygen binding sites in the haemoglobin in curve **B** are empty in the capillaries of the human lung? [1]

.....

*(b)* The curve is steepest in the region marked **X** on the graph. Explain how the steepness of the curve in region **X** helps the tissues in a mammal function more efficiently. [2]

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(1072-01)

*(c)* (i) Suggest a tissue in the body of a mammal where the partial pressure of carbon dioxide is likely to be as high as in curve **D**. [1]

.....

(ii) What is the advantage of an increasing partial pressure of carbon dioxide in a muscle? [2]

.....

.....

.....

.....

*(d)* (i) Explain the importance of the position of the dissociation curve of fetal haemoglobin. [2]

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.....

(ii) Curve **A** is similar to a curve obtained when investigating the oxygen carrying capacity of the respiratory pigment of a lugworm which burrows in mud. Explain how this curve indicates the worm's adaptation to its environment. [2]

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.....

**(Total 11 marks)**

**12.**

The table shows the maximum and minimum blood pressures (in kPa) at various points in the human circulatory system.

| | *Blood pressure/kPa* | |
|---|---|---|
| *Location* | *Maximum* | *Minimum* |
| Left ventricle | 16.0 | 0 |
| Right ventricle | 3.32 | 0 |
| Aorta | 16.0 | 10.65 |
| Pulmonary artery | 3.32 | 1.06 |
| Lung capillary | 1.06 | 0.66 |
| Muscle capillary in leg | 2.00 | 2.00 |
| Pulmonary vein | 0.66 | 0.26 |
| Vein in leg | 0.66 | 0.66 |

*(a)* Explain the reason for the difference between the maximum pressure in the left and right ventricles and explain why this difference is necessary. [2]

.....

.....

.....

*(b)* Give **one** possible reason for the difference between the minimum aorta pressure and the minimum pressure in the ventricles. [1]

.....

*(c)* With reference to the **functions** of arteries and capillaries, explain why it is necessary to have a difference between their pressures. [2]

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.....

.....

.....

*(d)* (i) Compare the values between muscle capillaries and lung capillaries. [2]

.....

.....

(ii) Suggest an explanation for these differences. [1]

.....

.....

*(e)* Explain how it is possible for blood to return to the heart when the vein pressures are so low. [1]

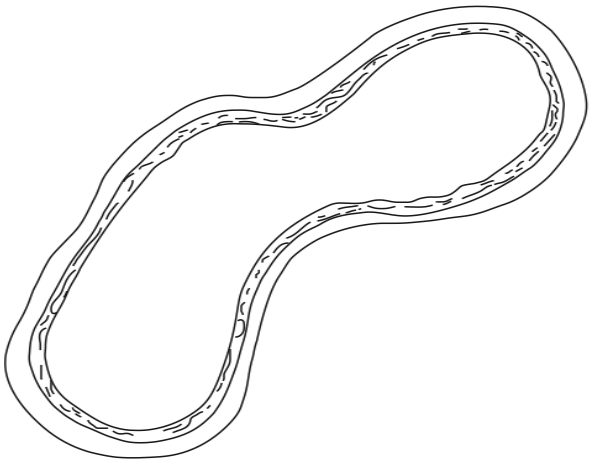
.....

.....

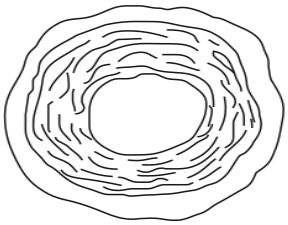
**(Total 9 marks)**

**13.**

*(a)* The diagrams show transverse sections of a vein and an artery (not drawn to the same scale).



Vein



Artery

State **three** differences between the artery and the vein that can be seen in the diagrams. [3]

1 .....

.....

2 .....

.....

3 .....

.....

1)

*(b)* Veins also possess valves to prevent the backflow of blood.

(i) Explain how a valve in a vein stops the backflow of blood. [2]

.....

.....

.....

(ii) Veins located in the head of a human do not have valves. Suggest a reason for this lack of valves. [1]

.....

.....

(iii) Veins carry blood back to the heart. Explain how blood is forced towards the heart in veins found in the legs. [2]

.....

.....

.....

*(c)* One of the functions of red blood cells is to transport oxygen from the lungs to respiring tissues.

(i) Explain how red blood cells are adapted to carry out this function. [3]

.....

.....

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.....

.....

(ii) State **one** *other* function of red blood cells. [1]

.....

**(Total 12 marks)**

**14.**

*(a)* Complete the following paragraph, about the heart and heartbeat, by inserting the most appropriate word or words. (Abbreviations will not be accepted.) [7]

The mammalian heart is made up of a special type of muscle called ..... muscle. This muscle has the ability to contract and relax without any stimulation and is therefore said to be ..... . The heartbeat is initiated in an area of the right atrium called the ..... . The wave of excitation passes across both atria until it reaches an area of tissue in the septum called the ..... . This in turn passes the wave to a group of fibres called the ..... which transfers the wave to the tip of the ventricles. This causes the ventricles to ..... from the base upwards and forces blood to flow out of the heart through the aorta and ..... .

*(b)* Explain why small, unicellular organisms do not require a specialised gaseous exchange surface and transport system. [4]

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**(Total 11 marks)**

**15.**

**3.** Before competing, athletes often train at high altitudes for several weeks after which time their red blood cell count increases. The table shows these changes in a group of athletes.

| *Altitude/m* | *Number of red blood cells* $/10^{12} dm^{-3}$ |
|---|---|
| 0 | 5.0 |
| 6000 | 6.20 |

*(a)* (i) Calculate the percentage increase in red blood cells in the athletes after several weeks at 6000 metres. Show your working. [2]

.....

.....

(ii) Explain the benefit of this increase in red blood cell count. [3]

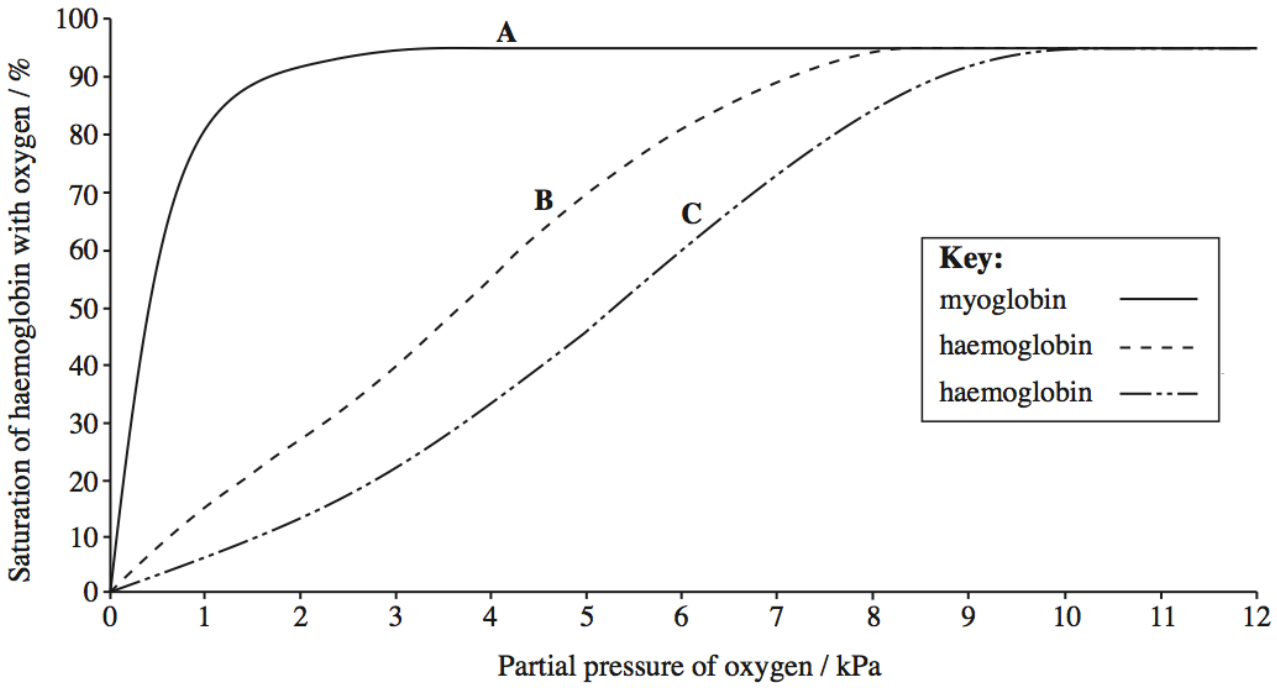
.....

.....

.....

.....

*(b)* The graph shows the oxygen dissociation curve of myoglobin (labelled **A**) and haemoglobin at two different partial pressures of carbon dioxide (labelled **B** and **C**).



(i) Name the form in which oxygen is transported in the red blood cells. [1]

.....

(ii) State the percentage (%) saturation of myoglobin at a partial pressure of 2kPa. [1]

.....

(iii) Which of the curves **B** or **C** shows the greater dissociation at partial pressures between 9 and 12kPa? [1]

.....

*(c)* Curves **B** or **C** could represent those for fetal and maternal haemoglobin.

(i) State which curve could represent fetal haemoglobin and give a reason. [2]

.....

.....

.....

(ii) Explain how this is an advantage to the fetus. [2]

.....

.....

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.....

*(d)* Myoglobin is an oxygen carrying pigment found in muscle cells. With reference to the graph suggest a function for myoglobin. [2]

.....

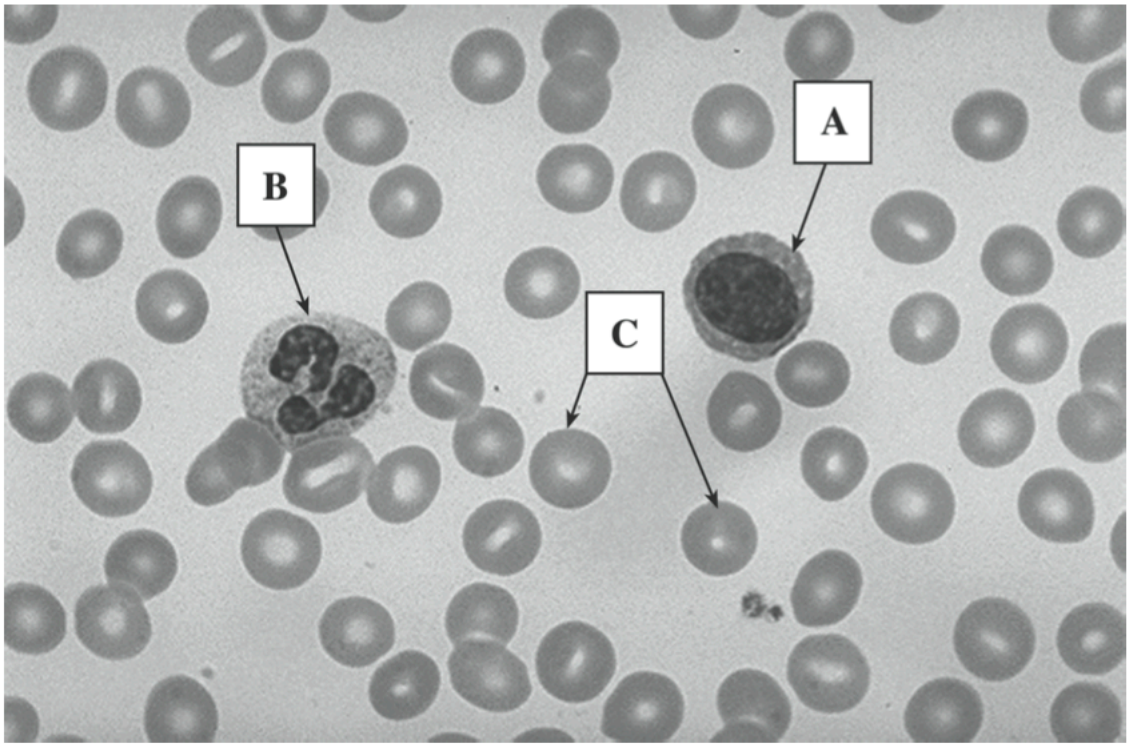
.....

.....

**(Total 14 marks)**

**16.**

The photograph below is of a human blood smear.




*(a)* Identify cells **A**, **B** and **C** by giving the correct terms below. [3]

**A** .....

**B** .....

**C** .....

*(b)* Explain how **two** features of cell **C** enable it to carry out its function. [2]

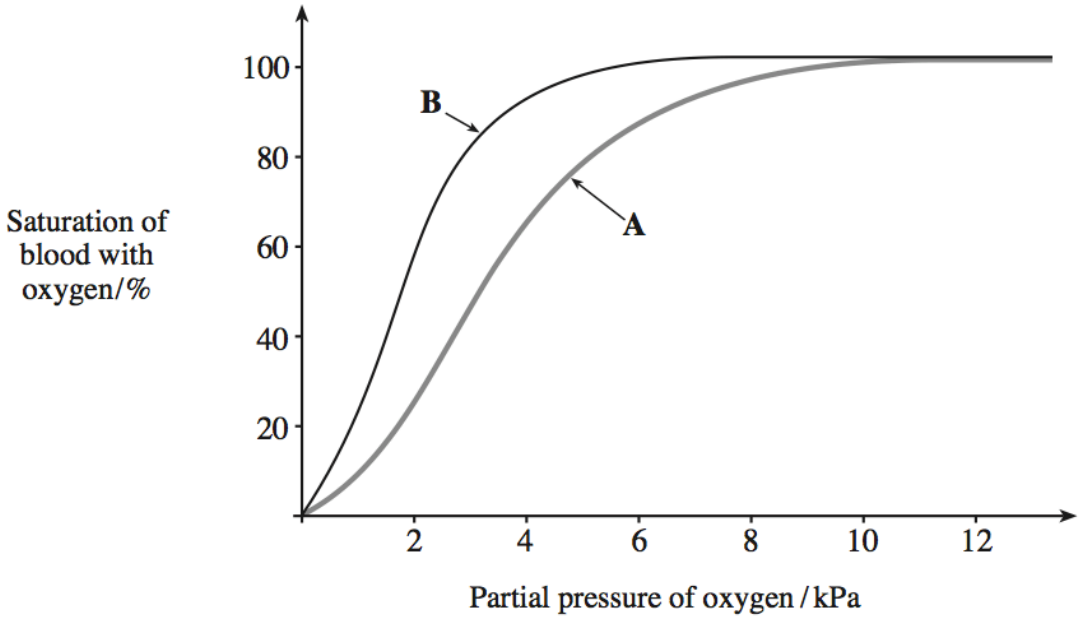
1. .....

.....

2. .....

.....

The graph below shows the oxygen dissociation curve for normal adult human haemoglobin (**A**) and *Arenicola* (lugworm) haemoglobin (**B**). *Arenicola* lives in muddy sand on the seashore.




*(c)* What is the advantage of the S-shaped curve shown by haemoglobin [2]

(i) in the tissues?

.....

.....

(ii) in the lungs?

.....

.....

*(d)* (i) Draw a line on the graph to show the effect on the human haemoglobin of being at a higher $CO_2$ concentration. [1]

(ii) Name this effect. ..... [1]

*(e)* (i) *Arenicola* has a curve to the left of human haemoglobin. What is the advantage of this to the lugworm? [1]

.....

(ii) What does this suggest about the conditions that *Arenicola* lives under? [1]

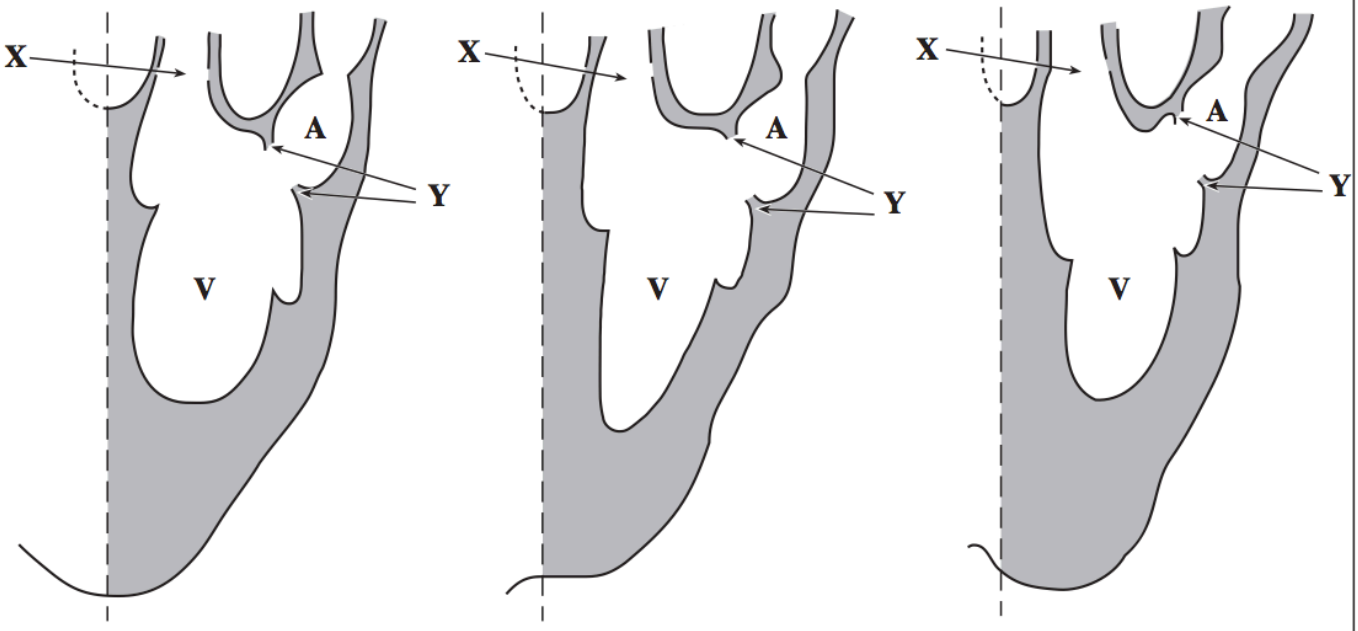
.....

**(Total 11 marks)**

**17.**

**4.** *(a)* The diagrams show the left side of the heart in three stages of the cardiac cycle. **X** and **Y** represent the position of valves but the drawing of them is incomplete.

Key:
**A** = left atrium
**V** = left ventricle




Atrial systole | Ventricular systole | Ventricular diastole

(i) Give the names of the valves at **X** and **Y.** [2]

**X** .....

**Y** .....

(ii) Complete each diagram by drawing the valve at position **X** and the valve at position **Y** in each case showing clearly whether they are open or closed. [3]

(iii) Valves **Y** are attached to the heart wall by tendons. What is the function of these tendons? [2]

.....

.....

.....

.....

*(b)* During fetal development there is an opening in the septum between the right and left atria. This opening normally closes after birth but in some cases it does not, this condition is known as 'hole in the heart'. Suggest the effects this non-closure might have on the blood circulation system and the tissues of the body. [2]

.....

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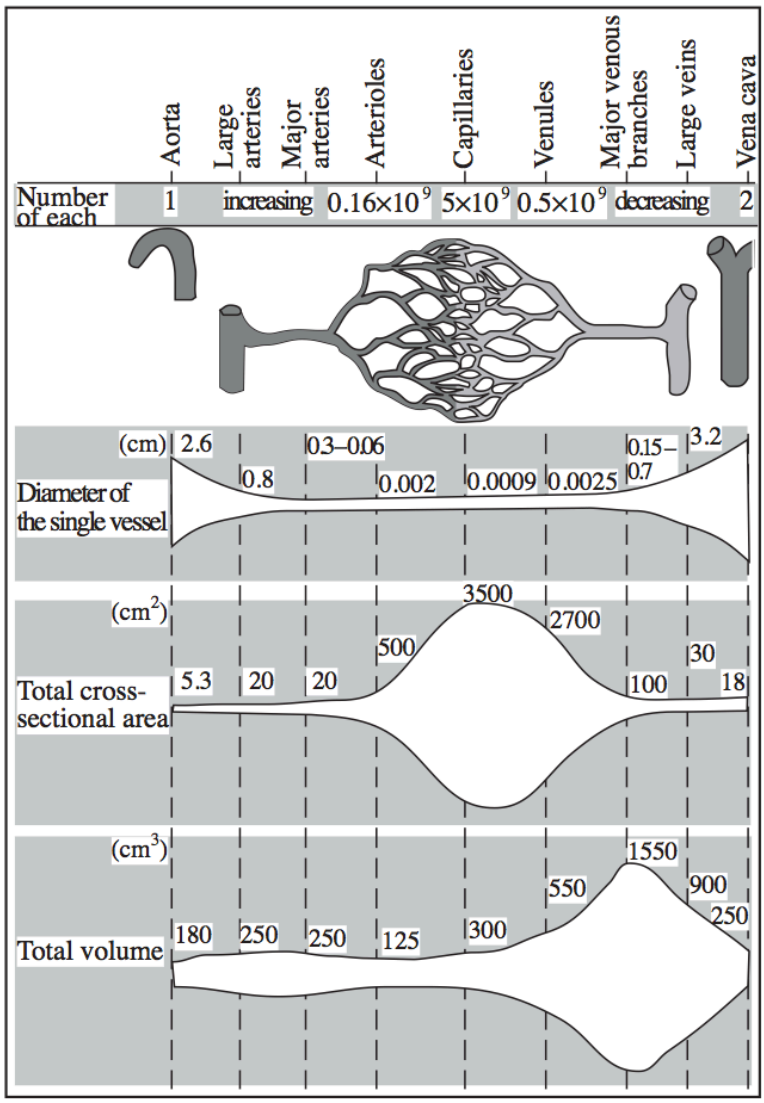
**(Total 9 marks)**

**18.**

The diagram shows the diameter of individual blood vessels, the total diameter of each type of vessel and the total volume of blood in each type of vessel.




http://www.newmanveterinary.com/circulat.html

*(a)* Using only information from the diagram, give **two** ways in which capillaries are adapted for the function of exchange. [2]

1 .....

2 .....

*(b)* Suggest why there is no exchange between the blood in the arteries, arterioles, venules and veins with the tissues. [1]

.....

.....

*(c)* In which type of blood vessels is the maximum amount of blood found? [1]

.....

*(d)* There are well developed circular muscles in the walls of the arteries. Give **two** functions of these circular muscles. [2]

1 .....

.....

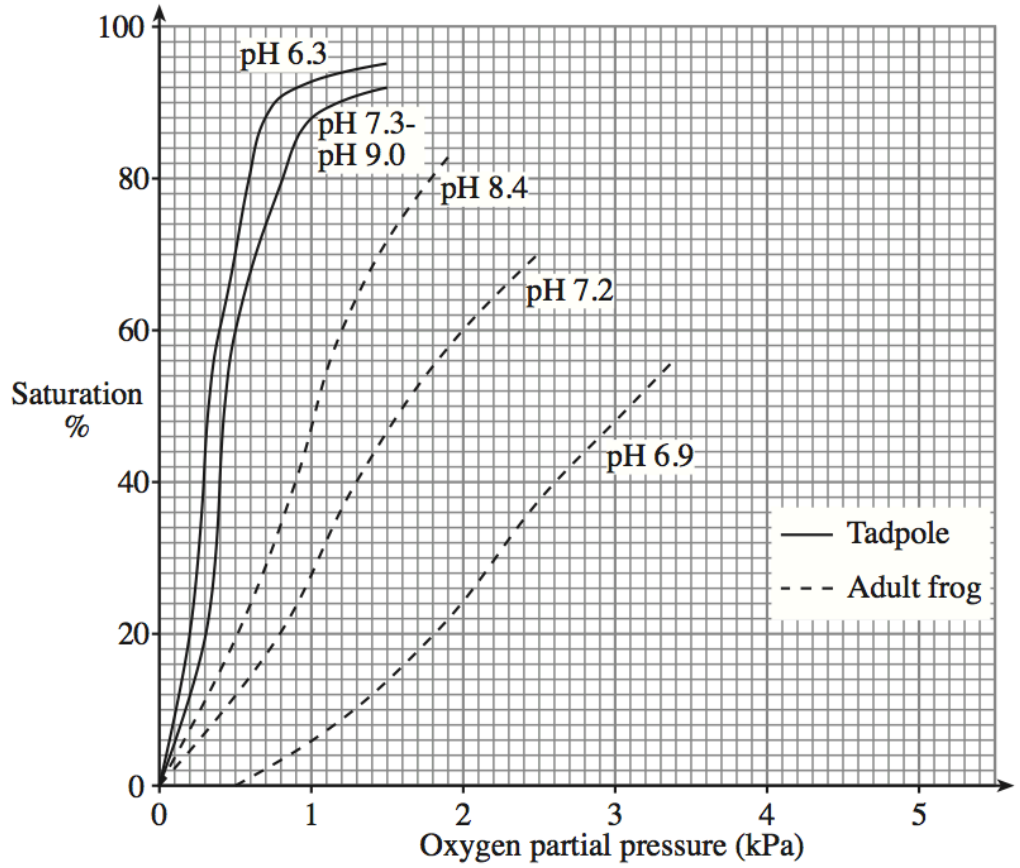
2 .....

.....

**(Total 6 marks)**

**19.**

Oxygen uptake by haemoglobin in blood is dependent upon the partial pressure of the available oxygen, the graphs show the relationship between haemoglobin saturation and partial pressure of oxygen in tadpole and in adult frog blood.




*(a)* State the percentage haemoglobin saturation at an oxygen partial pressure of 1 kPa in

(i) tadpole blood at pH 6.3, .....

(ii) adult frog blood at pH 6.9. ..... [2]

*(b)* Estimate the oxygen partial pressure for 50% haemoglobin saturation at pH 8.4 in

(i) tadpole blood, .....

(ii) adult frog blood. ..... [2]

*(c)* Describe the effect of increasingly acidic conditions upon the level of haemoglobin saturation in

(i) tadpole blood, [1]

.....

(ii) adult frog blood. [1]

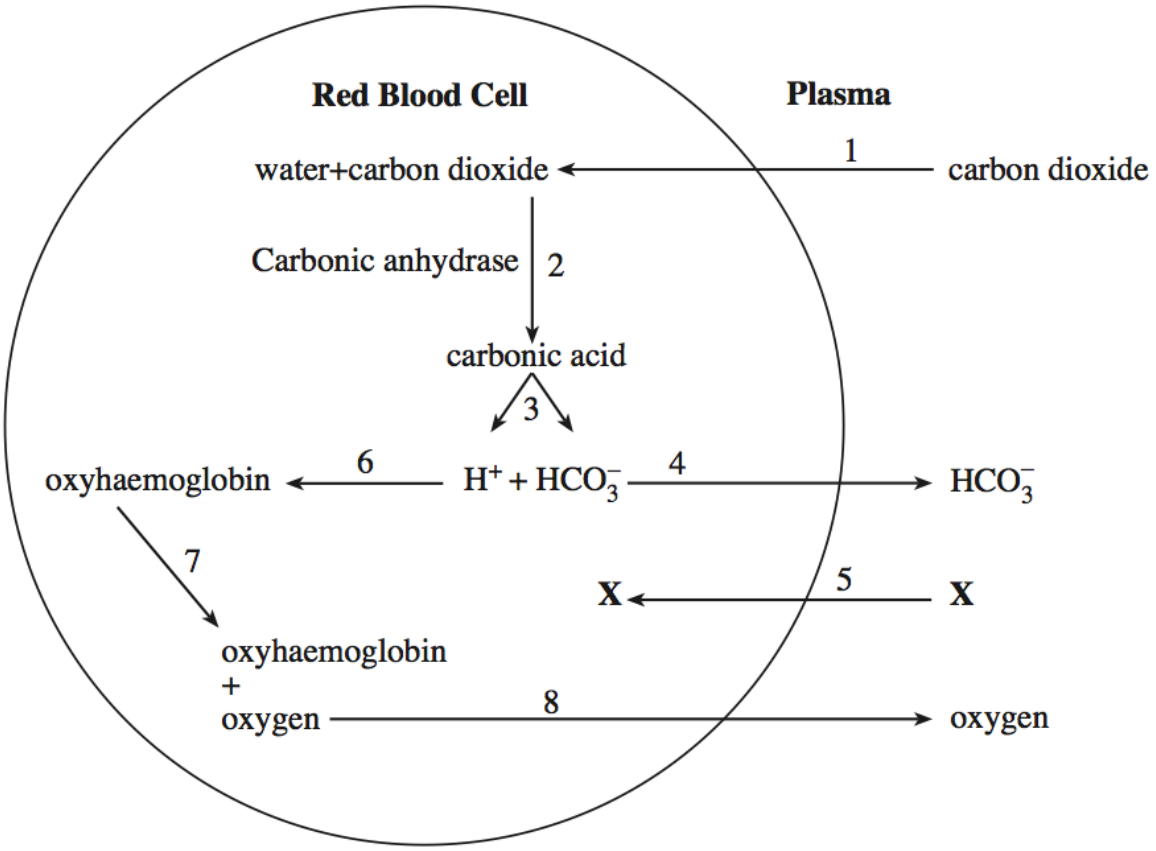
.....

*(d)* Tadpoles normally live in stagnant pools with low oxygen levels and high carbon dioxide content. Explain how tadpole blood is well adapted for life in low oxygen concentration. [1]

.....

.....

*(e)* The diagram shows the role played by red blood cells in the transport of carbon dioxide. The red blood cell shown is located in respiring tissue.




(i) Carbon dioxide dissolves only very slowly in water. Inside red blood cells however it dissolves quickly. Use information from the diagram to explain why carbon dioxide dissolves more quickly inside red blood cells. [1]

.....

(ii) Name the ions **X** which enter the red blood cells. [1]

.....

(iii) Explain why ions **X** move into the red blood cells. [1]

.....

(iv) Use steps 6, 7 and 8 to explain why a high carbon dioxide concentration in tissues causes more oxygen to be released by red blood cells. [2]

.....

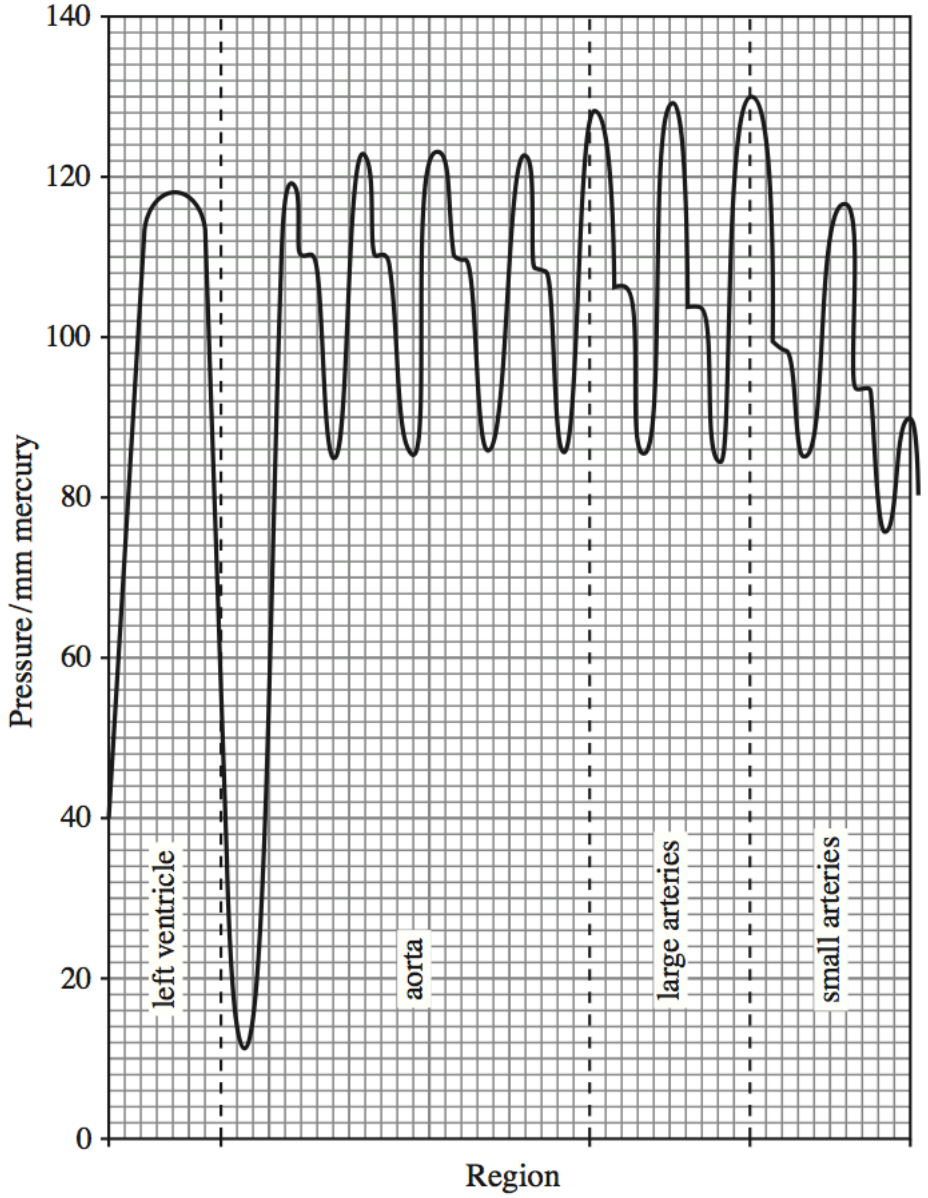
.....

.....

**(Total 12 marks)**

**20.**

The diagram shows pressure changes recorded as blood flows through the heart and the arteries.




*(a)* What is the value of the systolic pressure in the left ventricle? [1]

.....

*(b)* Fluids flow from regions of high pressure to regions of low pressure. The minimum pressure in the ventricle is lower than the minimum pressure in the aorta. Explain why blood does not flow back into the ventricle from the aorta. [2]

.....

.....

*(c)* Explain what causes the left ventricle pressure to fall to a very low value. [2]

.....

.....

*(d)* If the diagram had been extended to include the flow through the capillaries in the body, give **two** ways in which the trace would differ from the diagram given. [2]

.....

.....

*(e)* (i) Give **one** reason why the pressure in veins is lower than in capillaries. [1]

.....

(ii) How is flow maintained at this low venous pressure? [1]

.....

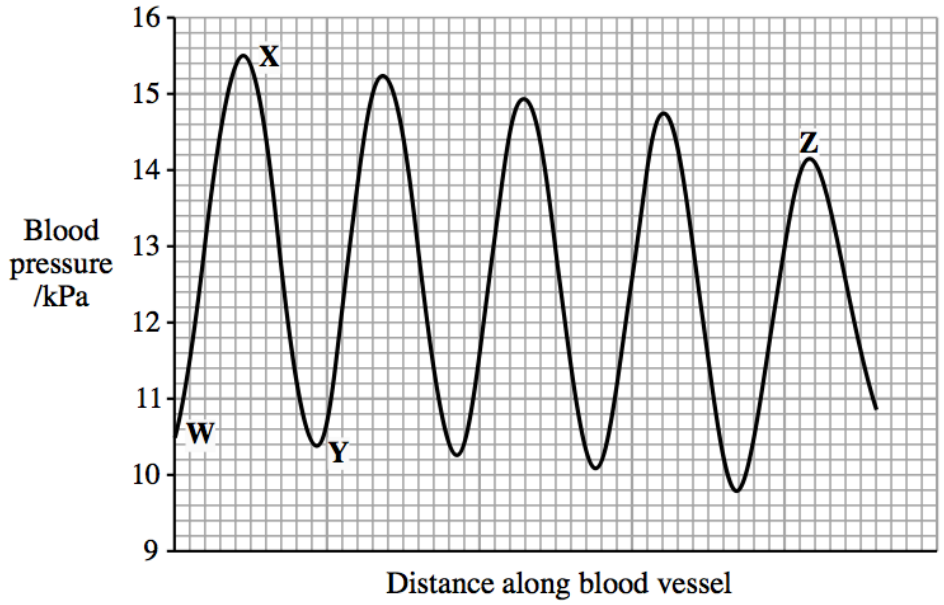
**(Total 9 marks)**

**21.**

**5.** *(a)* Give **three structural** differences between arteries and veins. [3]

| | *Artery* | *Vein* |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |

*(b)* The diagram below shows the pressure in a blood vessel at various points along its length.




(i) Name the **type** of blood vessel in which the measurements would have been made. [1]

.....

(ii) What is the difference in blood pressure between **W** and **X**? [1]

.....

(iii) What causes the increase in pressure between **W** and **X**? [1]

.....

(iv) Explain the fall in blood pressure between **X** and **Y**. [1]

.....

.....

(v) Suggest why there is a decrease in the overall **maximum** pressure between **X** and **Z**. [2]

.....

.....

*(c)* (i) State what is meant by the term *double circulatory system*. [2]

.....

.....

.....

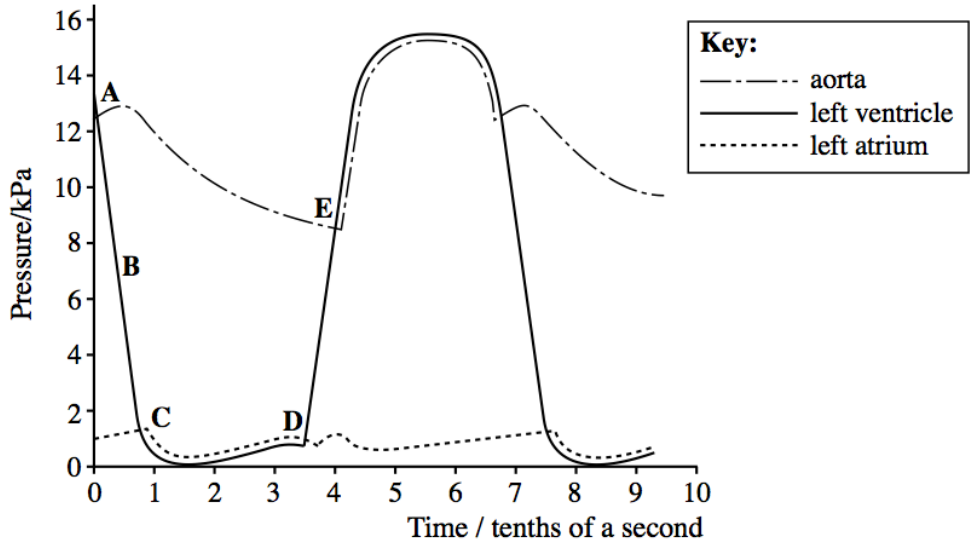
(ii) State what is meant by the term *closed circulatory system*. [1]

.....

**(Total 12 marks)**

**22.**

The graph shows changes in the pressure of blood in the left ventricle and aorta of a mammal during one complete cardiac cycle.




*(a)* Using the letters **A-E** as given on the graph state:

(i) the point at which the aortic valve is opened; [1]

.....

(ii) the period during which the bicuspid (atrio-ventricular valve) is open. [1]

.....

*(b)* Explain the changes that occur in the **volume** of blood in the left ventricle after point **E**. [2]

.....

.....

.....

*(c)* (i) Mark on the graph by means of an arrow labelled **X**, the point at which the aortic valve closes. [1]

(ii) Explain what causes the closing of the aortic valve. [2]

.....

.....

.....

*(d)* Give the **name** of the area of the heart where the heart beat is initiated. [1]

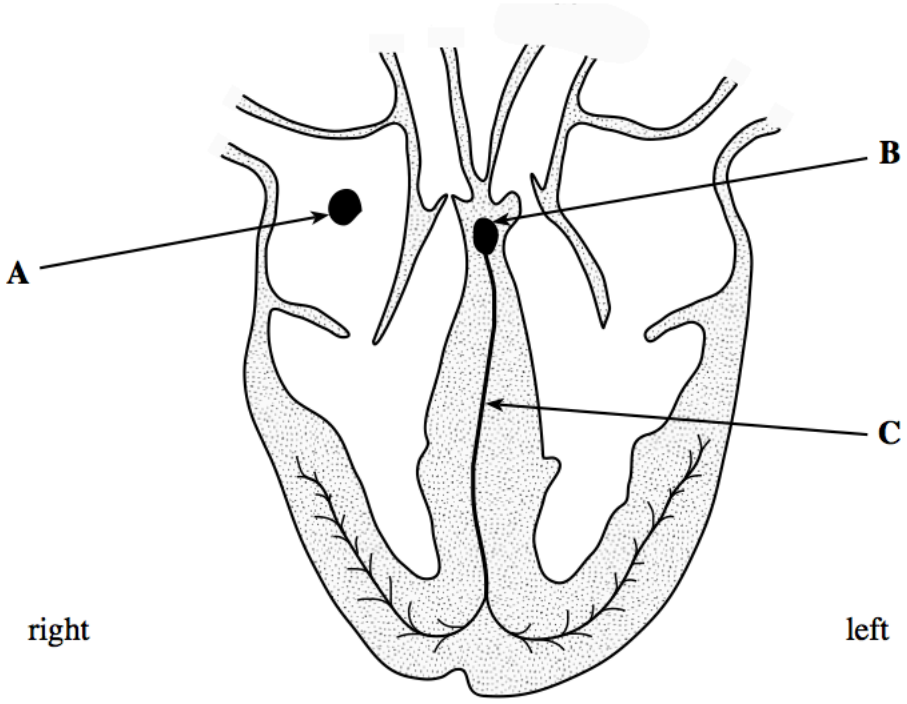
.....

**(Total 8 Marks)**

)6/15)

**23.**

*(a)* Name the parts labelled **A, B** and **C,** in the diagram of the heart given below. [3]




**A** .....

**B** .....

**C** .....

*(b)* Briefly describe the function of **each** part. [3]

**A** .....

.....

**B** .....

.....

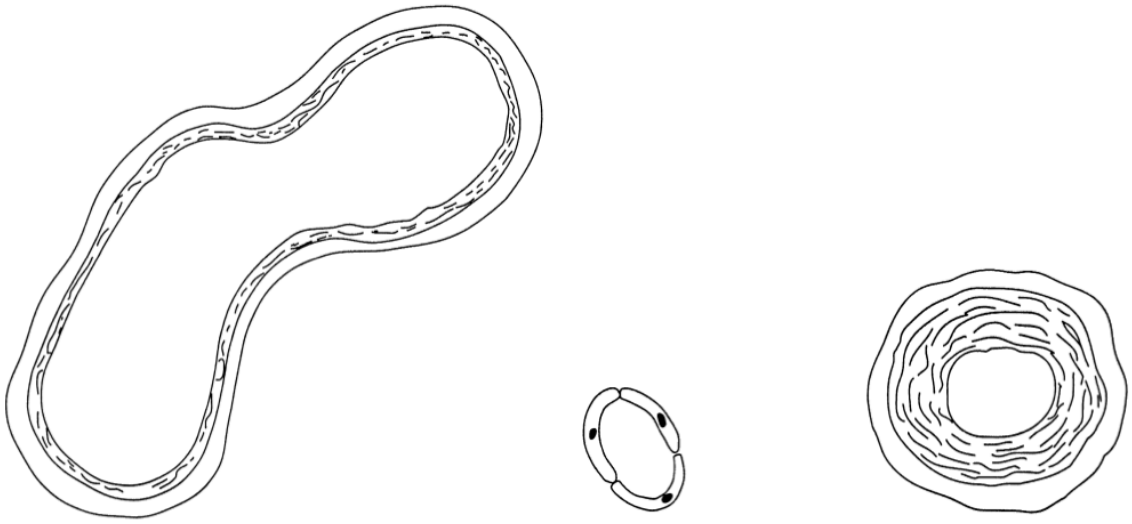
**C** .....

.....

**(Total 6 marks)**

**24.**

**4.** The diagrams below show transverse sections of three different types of blood vessel. They are not drawn to the same scale.



Vein Capillary Artery

*(a)* Complete the table giving **one** structural feature of each blood vessel and explain how this feature enables the vessel to carry out its function.

| *Vessel* | *Structural Feature* | *Function Related to Feature* |
|---|---|---|
| Vein | | |
| Capillary | | |
| Artery | | |

[6]

*(b)* State **one other** structure, not shown in the diagram, that is found in a vein. [1]

.....

**(Total 7 Marks)**

(X006/15)

**Essays**

**1.**

*(b)* Describe how arteries and veins are structurally adapted to their functions. [10]

**2.**

*(b)* Describe how the sequence of events that takes place during the cardiac cycle is initiated and controlled. [10]

**3.**

*(b)* Using a suitably drawn and labelled graph, explain what is meant by the oxygen dissociation curve for normal adult mammalian haemoglobin and, using additional lines on the graph, explain how this differs according to the environment in which the organism lives. [10]

**4.**

*(a)* Describe the **structure** of the circulatory system in a mammal. [10]

**5.**

*(a)* Describe the way in which normal heart beat is initiated and controlled. [10]

**6.**

*(a)* Explain how the cardiac cycle is initiated and controlled. [10]

**7.**

*(b)* Describe the changes in pressure which occur as blood flows from the heart through the various types of blood vessels and returns to the heart. Explain the cause of each of the changes you describe. [10]

**8.**

*(a)* Describe the structure and function of veins, arteries, arterioles and capillaries. [10]

**9.**

*(a)* Explain why multicellular animals require a transport system and gas exchange surfaces whereas unicellular animals do not. [10]